Towards a Neurophenomenology of Settlement Morphology

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Introduction

What exactly is a "Neurophenomenology of Settlement Morphology?" Let's begin like Socrates by defining our terms, since this set of words is not typically found together.

"Settlement" is the blanket term used by Human Geography to denote areas of the landscape modified for human habitation. In a classic study, Hudson (1970, p. 3) provides a useful overview:

> Whether the unit of settlement is the individual farm, the village, town, city or conurbation, there is plenty of variety in its spatial setting. The settlement is central to all human geography, modifying as it does the natural environment by intruding a cultural element. Any settlement can be studied in either a world or a regional context, but any settlement, if it is to be adequately appreciated, must be correlated with other facts of geography, *e.g*. relief, climate, geology and social and economic conditions.

One thought-provoking way to look at settlements is in respect to their *morphology*, that is, their structure and form. Morphology is related to 'pattern;' yet, whereas pattern may refer to a more or less static arrangement at any given time, or even to active components in a typology of design (Alexander, *et al.* 1977), morphology implies definite stages of *development* and thus movement and change. In this regard, it's interesting to observe that morphology is also a term native to Biology, especially in its variation *morphogenesis* – "the generation of form" (Ebert & Sussex, 1970, p. 10). According to the textbook *Biology* (Mader, 1990, p. 678), "Development requires growth, differentiation, and morphogenesis. When an organism increases in size, we say that it has grown…Differentiation occurs when cells become specialized with regard to structure and function…Morphogenesis goes one step beyond growth and differentiation. It occurs when body parts become shaped and patterned into a certain form." Applying this understanding to Human Geography, we could say that "settlement morphology" is an evocative way of focusing attention on how any particular human habitation system, at whatever scale, has developed over time into its current form – and, recalling the famous Bauhaus motto, it will be instructive to remember that "Form follows Function;" or, as Frank Lloyd Wright later redefined it, "Form and Function Are One" (Papanek, 1995, p. 140).

In the Summer of 1996, the International Seminar on Urban Form (ISUF) was established to mark the formal emergence of an interdisciplinary field. ISUF publishes an excellent quarterly journal entitled *Urban Morphology.* In an introductory article, Anne Vernez Moudon (1997, p. 3), from the Center for Architecture and Urban Planning at the University of Washington, explains:

> [Urban morphologists] analyze a city's evolution from its formative years to its subsequent transformations, identifying and dissecting its various components. The city is the accumulation and the integration of many individual and small group actions, themselves governed by cultural traditions and shaped by social and economic forces over time. Urban morphologists focus on the tangible results of social and economic forces: they study the outcomes of ideas and intentions as they take shape on the ground and mould our cities.[1]

Hence, as the scholarly site for an emerging interdisciplinary field, articles in *Urban Morphology* routinely examine social, cultural, historic, economic, architectural and/or planning "ideas and intentions" as they relate to, influence, and ultimately are embodied in evolving urban form.

Yet, as fascinating as this project is – and timely in bringing awareness to a contemporary settlement development that one well-known critic (Kunstler, 1993, p. 10) decries as "depressing, brutal, ugly, unhealthy, and spiritually degrading"[2] – a specifically *urban* morphology already reveals a predisposition and perhaps cultural bias. That's why in this paper I will stick with the geographic roots of a comprehensive "settlement morphology," recognizing the importance of urban factors yet wanting to include in my discussion multiple scales – or perhaps *form* itself as an archetypal expression.

Finally, as a further reflection of the inherent interdisciplinarity of a comprehensive settlement morphology, I wish to overlay another emerging field – neurophenomenology – onto the terrain. Neurophenomenology is a research program uniting recent discoveries in cognitive neuroscience with the philosophy of phenomenology, which is itself a particular way of perceiving 'essences' (Merleau-Ponty, 1962, p. vii), especially as they arise in direct lived experience. I hope to reveal that neurophenomenology may provide trenchant insight to the "ideas and intentions," or epistemological assumptions, that comprise the substratum of design and development decisions, at any scale.

[1] Coincident with the biological emphasis of this paper, Professor Moudon adds in her explanation: "The dynamic state of the city, and the pervasive relationship between its elements, have led many urban morphologists to prefer the term 'urban morphogenesis' to describe their field of study" (1997, p. 3).

[2] Kunstler's work may be considered representational of the tradition instituted by Lewis Mumford in treatises such as *The City in History* (1961), in which he railed against the deleterious effects of a "mechanistic" approach to settlement development, thus advocating the beneficial and wholesome consequences of "organic" morphology – as well as the more recent and explicit association with "The New Urbanism," championed by such notables as Leon Krier and Andres Duany.

Neurophenomenology

Concurrent with ISUF in 1996, Francisco Varela inaugurated the research program of neurophenomenology in his seminal paper "Neurophenomenology: A Methodological Remedy for the Hard Problem." And what is this "hard problem?" According to Chalmers (1995, p. 201, original emphasis), "The really hard problem of consciousness is the problem of *experience*" – or, as elaborated by Shear (1995, p. 359), "The 'hard problem' of explaining consciousness…is that of giving an intelligible account of why experience exists at all, and also of why it is found in intimate association with individual physical systems such as the nervous systems of human beings and other sentient creatures." Varela sought to address this so-called "hard problem" with the introduction of his new research program: "Neuro-phenomenology is the name I am using here to designate a quest to marry modern cognitive science and a *disciplined approach* to human experience, thus placing myself in the lineage of the continental tradition of phenomenology" (1996, p. 330, original emphasis).[3]

In order to comprehend why there was a problem at all, it will be necessary to backtrack a bit so as understand the position of this "modern cognitive science" to which experience is to be wed.

Cognitive science arose originally as a reaction to the prevailing Behaviorism of the early 20th century, which was itself an attempt to provide a purely scientific foundation for the emerging field of Psychology (Watson, 1913). Since Behaviorism positioned itself as 'scientific,' and thus modeled upon the objectivist epistemology of Physics, it proclaimed that the psychology of human beings could be studied most effectively by detached, independent observers without resort to intangible, distracting, even messy considerations such as 'mind' or 'consciousness.' In the words of one of its founders:

> Psychology…is a purely objective experimental branch of natural science. Its theoretical goal is the prediction and control of behavior. Introspection forms no essential part of its methods, nor is the scientific value of its data dependent upon the readiness with which they lend themselves to interpretation in terms of consciousness (Watson, 1913, as quoted in Thomas, 2001, p. 13).

[3] I don't know if Varela was aware of it but several years prior to his paper a team comprising Charles D. Laughlin Jr., John McManus, and Eugene G. d'Aquili assembled an intriguing book entitled *Brain, Symbol & Experience: Toward a Neurophenomenology of Human Consciousness* (1990). This book introduced such important concepts as "biogenetic structuralism" and "neurognosis," and the value of approaching the study of states of consciousness as a "mature contemplative." Laughlin, McManus, and d'Aquili situate themselves as anthropologists, which would place them in a different research community than Varela – and recalling that back in the early 90s there were no internet search engines, it is possible that Varela was unaware of this previous usage of the term neuro-phenomenology. In any case, I have not seen the anthropologists' book referenced in any of Varela's writings; though I shall have more to say of it later. See also Laughlin & Throop (2009) *Husserlian Meditations and Anthropological Reflections: Toward a Cultural Neurophenomenology of Experience and Reality.*

What resulted was the dubious "black box" approach, where inputs and outputs are diligently recorded but where the whole process in between – mind – is duly disregarded.

By the 1950s and early 1960s Behaviorism was losing its edge with the rise of computer science and its associated formal languages and interpretivist analytic philosophy. A new paradigm of Psychology, heralded as the "cognitivist revolution," alleged that the inner workings of the "black box" could indeed be studied with these new tools:

> The cognitive position was to adopt notions derived from logical and formal analysis, putting an emphasis on syntax. In this view, the mind, like a computer, is organized by rules and operates by mental representations. Meanings or semantics are supposed to arise by mapping these rules onto classically categorizable events and objects. Unlike behaviorism, this view allowed one to look into the mind but then described it as if it were a formal system. This description floated more or less free of the detailed structure of the brain (Edelman, 1992, p. 67).

This whole "computer metaphor" – an abstract "computationalism" where the brain is accepted as the generic "hardware" upon which any suitable proprietary "software" of mind can be run – may sound very familiar; yet, Edelman, a Nobel Laureate, declares elsewhere (p. 14) that the whole cognitivist enterprise is "incoherent," "[resting] on a set of unexamined assumptions." One of its most glaring oversights is that "it makes only marginal reference to the biological foundations that underlie the mechanisms it purports to explain. *The result is a scientific deviation as great as that of the behaviorism it has attempted to supplant*" (ibid, added emphasis). According to Edelman, any viable theoretical construction of mind or mental processes must be based upon and reflect the actual physical structure of the brain. "What is special about brains that computers, and material particles, and atoms, and *res cogitans* all lack is *evolutionary morphology*" (ibid, p. 29, added emphasis) – "the minimum condition for the mental is a specific kind of morphology" (ibid, p. 34).

This finding certainly makes an interesting correlation with the study of settlement morphology; for, I am tempted to ask, "Would specific kinds of settlement morphology also influence mental functioning?" This will become a recurring theme.

In a later book co-authored with Guilio Tononi, Edelman presents further evidence from his research to delegitimize the computer metaphor. Once again, what appears most significant in the construction of mental processes is the evolutionary "organization principles" among various components of the nervous system:

> [A] quick review of neuroanatomy and neural dynamics indicates that the brain has special features of organization and functioning that do not seem consistent with the idea that it follows a set of precise instructions or performs computations. We know that the brain is interconnected in a fashion no man-made device yet equals. First, the billions and billions of connections that make up a brain's connections are not exact: If

> we ask whether the connections are identical in any two brains of the same size, as they would be in computers of the same make, the answer is no…Although the overall pattern of connections of a given brain is describable in general terms, the microscopic variability of the brain at the finest ramifications of its neurons is enormous, and this variability makes each brain significantly unique (Edelman & Tononi, 2000, p. 47).

The authors go on to explain further that the uniqueness of each brain results from "the consequences of both a developmental history and an experiential history" (ibid); thus, personal experience is indubitably implied in the mental functioning of each individual. What's more, at the level of consciousness, or subjective experience, neuronal connectivity is never "hard-wired," to use a favorite mechanistic metaphor: new synaptic connections are made with each new experience while existing connections wither and fade with disuse – and this variability compounds on a daily basis. The picture that is painted by recent findings in cognitive neuroscience portrays a nervous system of dynamic adaptability, both shaping and shaped by its everyday lived experience. No machine could ever match this evolutionary dynamism. For that reason, it is disappointing to hear prominent spokes-people still clinging to the outworn mechanistic metaphors. For example, the respected neuroscientist Michael S. Gazzaniga, in a recent issue of *Brain in the News* (2011, p. 5), says flatly, "I think we will get over the idea of free will and accept we are a special kind of machine, one with a moral agency which comes from living in social groups."

And so, with the epistemological assumptions that guided early cognitive science – and in many cases still linger – it becomes easy to comprehend why the "hard problem" would arise: the cognitivist enterprise has been intrinsically and emphatically *disembodied*. The living body is the very locus of experience – experience is *being* (Thompson, 2004, p. 382), the type of being that comes from subjectively inhabiting a body. Each body, each nervous system, each brain is unique, shaped by its own personal developmental history. For that reason, universal generalizations do not apply: discoveries at the level of neuroscience must be correlated with subjective accounts. For too long, the cognitivist enterprise dismissed the subjective in its zeal to forward purely objective, scientific explanations. Varela, in his new research program of neurophenomenology, sought to find verifiable (and thus scientific) common ground between subjective (i.e. phenomenological) and objective accounts not by abandoning altogether the cognitive enterprise but by introducing a "methodological remedy" that could "bridge the gap" (Roy*, et al*. 1999), thus lending respectability to both. In his own words: "At the very least, the hypothesis presented here provides an explicit avenue to conduct research in cognitive science as if both brain physiology and mental experience mattered" (1996, p. 344). "[W]e have in front of us the possibility of an open-ended quest for resonant passages between human experience and cognitive science. The price however is to take first-person accounts seriously as valid domain of phenomena" (ibid, p. 346).

The Embodied Mind

In a recent summation entitled *Embodied Cognition* (2011, p. 54) – which appears to me at times as a somewhat disguised effort to revive credibility in the cognitivist enterprise by demonstrating recent advances in artificial intelligence and *robotics*[4] – Shapiro states: "Within embodied cognition, Varela, Thompson, and Rosch's *The Embodied Mind* (1991) is often regarded as an *urtext*" (meaning "a basis for variants in later texts" (Dictionary.com)). After explaining that the authors "reject the traditional view of cognition as computation over representation, choosing instead to conceive of cognition as "embodied action,"" Shapiro selects the following paragraph to encapsulate the message of *The Embodied Mind*:

> By using the term *embodied* we mean to highlight two points: first, that cognition depends upon the kinds of experience that come from having a body with various sensorimotor capacities, and second, that these individual sensorimotor capacities are themselves embedded in a more encompassing biological, psychological, and cultural context. By using the term *action* we mean to emphasize once again that sensory and motor processes, perception and action, are fundamentally inseparable in lived cognition (Varela, Thompson & Rosch, 1991, p. 173).

I initially encountered *The Embodied Mind: Cognitive Science and Human Experience* during a study of Living Systems Theory back in my Whole Systems Design program, a study in which I first read Maturana and Varela's (1987) *The Tree of Knowledge: The Biological Roots of Human Understanding.* I must say, I have been profoundly influenced ever since, for I can no longer take my body for granted. Both these important texts, and the understandings they convey, can be considered as predecessors to Varela's program of Neurophenomenology. Of particular relevance to a "Neurophenomenology of Settlement Morphology" are three key terms: "autopoiesis," "structural coupling," and the "enactive approach" to cognitive science.

Autopoiesis is understood as the dynamics of "self-organization." All living systems are considered as "autopoietic unities" in that they are *self*-organizing, *self*-maintaining, *self*-repairing wholes. All organisms, for example, are certainly living systems but not all living systems need be organisms, and could include such autopoietic unities as ecosystems or even traditional villages. Laughlin, *et al*. (1990, pp. 70-5) emphasize that individual neurons are also self-organizing, a process they call "neurognosis," and thus are capable of intentional behavior.

[4] As is Andy Clark's *Supersizing the Mind: Embodiment, Action, and Cognitive Extension* (2011). Both authors are willing to apply a growing acceptance of "embodiment" within cognitive science to robotics research, which seems to me a misapplication. "Clark's position seems to be that cognitive science might retain the [computational] framework, but would do well to focus its energies on understanding the extent to which body and world are factors in cognitive processes (Shapiro, 2011, p. 66). Yes, this is the right language, but it seems to me inappropriate to apply it to machines; or rather computationalism can *only* be applied to machines.

"The most striking feature of an autopoietic system is that it pulls itself up by its own bootstraps and becomes distinct from its environment through its own dynamics, in such a way that both [entities] are inseparable…Living [systems] are characterized by their autopoietic organization. They differ from each other in their structure, but they are alike in their organization" (Maturana & Varela, 1987, pp. 46-7) – an organization with the ultimate purpose of maintaining long-term viability in relationship to environment.

The essential point here is one of *autonomy* – self-direction or self-management. This point becomes clearer when contrasting autopoietic *living* systems with *mechanical* systems, which are characterized as being "allopoietic," or organized from without. A computer, for example, can never self-organize but must be constructed by technicians. And whereas a traditional village is certainly self-organizing, in the sense that it is constructed and maintained by the people who live there, most modern settlements, such as suburban subdivisions or downtown business districts, need to be constructed and maintained by outside contractors, which means that the settlement loses autonomy. Such a condition also indicates that settlements like this are just more allopoietic mechanical systems. When a mechanical system breaks down, who will repair it? Living systems repair themselves.

Structural coupling is a very important consideration. In the words of the founders: "We speak of structural coupling whenever there is a history of recurrent interactions leading to the structural congruence between two (or more) systems" (Maturana & Varela, 1987, p. 75). If I may paraphrase, *the organism structurally influences the environment as much as the environment structurally influences the organism* – they are *co*-evolutionary, *co*-determining, and *co*-specifying. This brings up an important question raised earlier: If human beings co-evolve with an environment through a history of structural coupling, could not the quality and characteristics of that environment – perhaps even its *morphology* – influence the potentials of the human beings residing therein? I believe this possibility has not been adequately addressed in the literature, so I will return to it; for now, let's take a look at the "enactive approach," which is congruent with the concept of structural coupling.

"We propose as a name the term *enactive* to emphasize the growing conviction that cognition is not the representation of a pregiven world by a pregiven mind but is rather the enactment of a world and a mind on the basis of a history of the variety of actions that a being in the world performs" (Varela, Thompson & Rosch, 1991, p. 9). "We are claiming that organism and environment are mutually enfolded in multiple ways, and so what constitutes the world of a given organism is enacted by that organism's history of structural coupling" (ibid, p. 202). "Consequently, cognition is no longer seen as problem solving on the basis of representations; instead, cognition in its most encompassing sense consists in the enactment or bringing forth of a world by a viable history of structural coupling" (ibid, p. 205).

These ideas stir my imagination. If cognition is indeed "bringing forth a world," then it must be possible, through disciplined training of the cognitive processes – that is, thinking, feeling, concentrating, imagining, visioning, etc. – to bring forth a *desired* world. This would be, in the language of phenomenology, *intentionality* – or, from another school, the open-ended creativity inherent in *design*. We *can* design the world we would choose; we do not need to passively accept a 'pregiven' world 'out there,' any old world that's been handed down to us. And, with an understanding of the ultimate implications of structural coupling, we can design this world (*a* world, multiple worlds) to set the stage for and facilitate our conscious evolution. What could be more enlivening than that? The first step, it would seem, almost paradoxically, is to turn inward and become fully *embodied*, fully present in the body, for that is where mind emerges, a clear and purposeful mind, mind as the emergent cognitive interface between embodied being and nurturing environment. This is the potential of *The Embodied Mind*; and this is perhaps why the authors include a detailed discussion of Buddhist meditative practice in the book.

Thompson and Varela (2001, pp. 423-4), collaborating once again ten years after the publication of *The Embodied Mind*, appear to have sensed these possibilities:

> The nervous system, the body and the environment are highly structured dynamical systems, coupled to each other on multiple levels. Because they are so thoroughly enmeshed – biologically, ecologically and socially – a better conception of brain, body and environment would be as mutually embedded systems rather than as internally and externally located with respect to one another.

"Mutually embedded" indeed, an integrated unification, to the degree that modification or transformation in one will inevitably initiate change in the others. Move from a cantankerous inner city to a verdant garden landscape and you are bound to produce new thought patterns!

And what about this phenomenon of movement? Having a body or being embodied implies mobility, getting around and exploring the environment, looking for "affordances" (Gibson, 1979), that is, *opportunities for enaction*. The authors do address this issue in their new collaboration, suggestively entitled "*Radical* Embodiment: Neural Dynamics and Consciousness" (added emphasis), an apparent reference to an evolved viewpoint, and I quote the full paragraph to integrate the new language:

> Situated activity takes the form of cycles of sensorimotor coupling with the environment. What the organism senses is a function of how it moves, and how it moves is a function of what it senses. The substrates of these cycles are the sensorimotor pathways of the body, which are mediated in the brain by multiple neocortical regions and subcortical structures. Transient neural assemblies mediate the coordination of sensory and motor surfaces, and sensorimotor coupling with the environment constrains and modulates this neural dynamics. It is this cycle that enables the organism to be a situated agent (p. 424).

When I first read that I made a little note: “What about people in cars?” For it seems that what’s being described here is the genesis of neural patterning, the instantiation of neural networks, as a function of the movement cycles of the organism. Structural coupling, then, becomes more completely apprehended as a history of *sensorimotor* coupling. A theoretical person sitting in a chair in a dark room their whole life will not embody the same neural dynamics as one actively out exploring the environment. The mind is not a “black box;” nor is it pregiven but rather is continually constituted and re-constituted with each new passing adventure. From this perspective, the person in a car, virtually immobilized with arms and legs stretched forward in an unnatural posture, encapsulated within a metallic shell, shielded from the multitude of sensory information vibrating as energy in the environment, will have limited opportunities for developing complex and sophisticated sensorimotor neural dynamics.

And so I need to return to my recurring question: Is not the specific structuring of the environment being imprinted somehow in the neural patterning of the brain simply through the sensorimotor act of mobility? Does this not imply that different modes of mobility will produce different neural patterning resulting in different brain dynamics and thus, ultimately, different ways of perceiving the world (i.e. different worldviews)? Or, alternately, would not the movement through different settlement morphologies, even via the same mode of mobility, consequently produce different neural morphologies in the developmental cycling sequences explicated by Edelman? If not entirely isomorphic, could not the relationship between settlement morphology and brain microstructure be at least reflective? With these questions it is time now to turn to the issue of the neurophenomenology of settlement morphology. In preparation, I close this section with the thoughtful ruminations of Evan Thompson, gifted son of Lindisfarne, who has contributed so much to our appreciation of the embodied mind:

> For neurophenomenology…the guiding issue isn’t the contrived problem of how to derive a subjectivist concept of consciousness from an objectivist concept of the body. Instead, it’s to understand the *emergence of living subjectivity from living being, including the reciprocal shaping of living being by living subjectivity.* It’s this issue of *emergence* that neurophenomenology addresses, not the Cartesian version of the hard problem (Thompson, 2004, p. 385, original emphases).

Isn’t it curious that Thompson still feels the need to reference the “hard problem,” as a point of contrast – especially considering that some thirteen years earlier, in *The Embodied Mind*, he was writing: “we discussed how cognitive science has slowly drifted away from the idea of mind as an input-output device that processes information toward the idea of mind as an emergent and autonomous network” (1991, p. 151). It seems that the Cartesian mind/body split endures even after so much evidence acquired to repudiate it. How to explain this phenomenon? Could Cartesian proponents embody different neural dynamics? Could this be the result of structural coupling with environments that perpetuate Cartesian dualism?

Methodological Considerations

Lutz and Thompson (2003, p. 31) distinguish two levels to the neurophenomenology research program: "At a theoretical level, neurophenomenology pursues an embodied and large-scale dynamical approach to the neurophysiology of consciousness (Varela, 1995; Thompson and Varela, 2001; Varela and Thompson, 2003). At a methodological level, the neuro-phenomenological strategy is to make rigorous and extensive use of first-person data about subjective experience as a heuristic to describe and quantify the large-scale neurodynamics of consciousness (Lutz, 2002)." This is the marriage of cognitive science and a disciplined approach to human experience – objective data correlated with subjective accounts – that Varela envisioned in his seminal article of 1996.

Lutz (2002) conducted a classic pilot study that demonstrates the essential interplay between these theoretical and methodological levels, between cognitive science and the philosophy of phenomenology. Explains Lutz:

> This recent work (Lutz, et al., 2002) studies the correlation between on-going conscious states and brain coherent dynamics during a simple perceptual task and illustrates how accounts of experience by trained subjects and experimental data from these experiences can share an explicit relation of "mutual or reciprocal constraints" (Varela, 1996). The first claim is that the basic study discussed here already validates this research program because it produces new data and illuminates their relation to subjective experience (pp. 133-4).

In Lutz's study, participants were guided through a well-known illusory depth perception task, which consisted of fixing on a "dot pattern containing no depth information" (Lutz, 2002, p. 144). After this preparation period, "the random dot pattern was changed to a slightly different random-dot pattern with binocular disparities (autostereogram). Subjects were readily able to see a 3-D illusory geometric shape (depth illusion)" (ibid, pp. 144-5). Finally, participants were asked to press a button when the geometric shape had completely emerged. While all this was going on, electrical brain activity was being recorded with an electroencephalogram (EEG). After each test run, or alternately *during* the test run, participants provided a verbal phenomenological account of the experience. Two to three sessions were recorded for each participant so that singularities might emerge and be compared against the backdrop of a collective mean.

The results proved to be very interesting, "validating" the research program as indicated. Lutz and his team felt the need to divide the trials into several "phenomenological clusters," categories of subjective experience based on self-reported degrees of readiness for the task. The phenomenological clusters were then compared with scientific data from EEG signals looking for correlation. Among the findings (Lutz, 2002, pp. 148-9):

> We found that the preparatory state, as reported by the subjects, modulates both the behavioral performance and the brain responses that follow. The reaction times were dependent on the degree of preparation reported by the subjects: they were longer when the subjects were less prepared. The induced response…was modulated in amplitude in posterior electrodes (visual areas) in function of the degree of preparation…In this particular example of clusters we can see a similar topographical pattern of large-scale synchrony during the motor response in the prepared versus the unprepared pattern…This later pattern of synchrony correlates in the unreadiness cluster of trials with longer reaction times.

Lutz is quick to point out: "This simple case study is just a first-step but already illustrates how fertile this approach could be to identify biophysical properties and to understand their relation to experience…The objective is to pay more meticulous attention to the intimate and direct knowledge that a subject has about his/her experience and to access this knowledge in a sufficiently controlled manner so that it is compatible with the more traditional methods for the collection of neural data" (2002, p. 149). A first evaluation is: "Further refinement is needed to capture the potential richness of even this simple perceptual experience. This depends primarily on the possibility of working with subjects trained to discriminate and stabilize their experience" (ibid).

I have two observations to make in regard to this pilot study:

First, I wonder if participants sitting in a chair and gazing into a computer screen, as I am assuming is the case here, will effectively stimulate the same sensorimotor capacities activated during actual lived experience? That is, I wonder if the neurodynamics data, as measured on the EEG, is already influenced by the artificial laboratory conditions? Such artifice is commonplace in cognitive neuroscience research due to the specialized, complex, and very expensive equipment involved. For example, Cupchik, *et al*. (2009, p. 84) "sought to determine how cognitive control and perceptual facilitation contribute to aesthetic perception along with the experience of emotion." Their method was to have participants lie in a functional Magnetic Resonance Imaging (fMRI) scanner whereupon they were shown a series of images of representational paintings. Brain areas that "lit up" during the experiment were assumed to correlate with aesthetic perception. There *may be* a connection; yet, the appreciation of artwork is usually more of a whole body affair, a gestalt, as viewers tilt their head this way or that, or physically move to various viewing positions to gain different perspectives or lighting affordances. I know that the new neuroscience technology is providing fascinating insight, and the studies continue to multiply, yet I also sense a tendency toward reductionism. Enactive and embodied proponents continually emphasize the essential *sensorimotor* component to cognition (Gallagher, 2005; Johnson, 2007; Noe, 2006; Sheets-Johnstone, 2011; Thompson, 2004, 2005; Thompson & Varela, 2001; Varela, *et al*. 1991), as perhaps exemplified in Thompson's skillful statement (2006, p. 226): "The central idea of the embodied approach is that cognition is the exercise of skillful know-how in situated action." With that in mind, maybe the best way to conduct cognitive neuroscience research would be to have brain imaging scanners mounted in helmets (if that could ever be arranged), allowing participants active mobility in everyday lived experience while they were being scanned. Wouldn't that be a more complete and authentic method for revealing underlying neural dynamics than the immobile simulations in laboratories?

The second observation regarding Lutz's study is that Varela (1996), in his inaugural paper, already anticipated the need for training in a "disciplined approach" to first-person accounting in order to substantiate neurophenomenology. Accordingly, the authoritative compilation *Naturalizing Phenomenology* (1999) – where "naturalizing" is understood as aligning phenomenology with the natural sciences, as in the project of neurophenomenology – makes repeated reference to Husserlian phenomenology and its essential technique of the *epoche*, or "transcendental reduction," a "bracketing" of habitual attitudes so that essences may be perceived. Similarly, an entire issue of the *Journal of Consciousness Studies*, reprinted in book form (with commentaries) as *The View from Within: First-person Approaches to the Study of Consciousness* (1999), was devoted to a discussion of first-person methodologies. In this book, Natalie Depraz, an Husserlian scholar, contributed a pragmatic article entitled "The Phenomenological Reduction as *Praxis*," in which she explains, "the *epoche* corresponds to a gesture of suspension with regard to the habitual course of one's thoughts, brought about by an interruption of their continuous flowing" (p. 99). Additionally, it ought to be remembered that *The Embodied Mind* incorporated detailed description of Buddhist mindfulness meditation, a technique for investigating consciousness with inherent "phenomenological precision" (Thompson, 2006, p. 228). With all this conscientious preparation, it seems a bit of oversight for Lutz to exclaim in his evaluation: "Further refinement…depends primarily on the possibility of working with subjects trained to discriminate and stabilize their experience" (2002, p. 149). That could have been anticipated and rehearsed ahead of time.

The citation of one more study will help to round out this look at methodological considerations. Varela's contribution to *Naturalizing Phenomenology*, besides editing, was a piece entitled "The Specious Present: A Neurophenomenology of Time Consciousness." His purpose was "to propose an explicitly naturalized account of the experience of present nowness based on two complementary approaches: phenomenological analysis and cognitive neuroscience" (1999, p. 266). His methodology was to review prior scholarly investigations of time consciousness, especially Husserl's conceptualization of *retention* and *protention*, add his own subjective experiences, correlate all these with recent research into the "dynamics of multistability" and the "geometry of nonlinear flows," and then finally develop his own hypothesis of "the four-fold structure of nowness," complete with diagrams (p. 303). The point is that he developed a sophisticated neurophenomenological description without having to use any test equipment himself. As might be expected from the originator of the enactive approach, Varela at one point in the study provides the following context:

> As phenomenological research itself has repeatedly emphasized, perception is based in the active interdependence of sensation and movement. Several traditions in cognitive research have, as well and in their own way, identified the link between perception and action as key. It is this *active* side of perception that gives temporality its roots in living itself (p. 272, original emphasis).

Towards a Neurophenomenology of Settlement Morphology

The embodied-enactive approach can also be considered an "ecological" approach, where "cognition is best characterized as belonging to embodied, situated agents – agents who are *in-the-world*" (Gallagher & Varela, 2001, p. 19, original emphasis). This could relate to Gibson's "ecological approach to visual perception" (1979), where the senses are understood not as passive receptors but rather as active "perceptual systems" (Gibson, 1966). "The perceptual systems, including the nerve centers at various levels up to the brain, are ways of seeking and extracting information about the environment from the flowing array of ambient energy" (Gibson, 1966, p. 5). And then the psychologist Hunt (2007, p. 210) speaks about "a primary "ecological" or "bodily" self, "prenoetic" and basic to perceptual-motor navigation and postural-spatial orientation." This is what Damasio (1999, p. 153-4) refers to as the "proto-self," "a preconscious biological precedent," "a coherent collection of neural patterns which map, moment by moment, the state of the physical structure of the organism in its many dimensions." According to Hunt (p. 223): "There is much cumulative evidence for the association of superior performance in physical balance and spatial-analytic abilities – as at least partial indicators of embodied presence – with states of consciousness and forms of imaginative absorption that could be considered as broadly creative, integrative, and/or spiritual." If accurate, this association would help to confirm the idea of non-localized, "widespread synchronization of the activity of different groups of active neurons distributed across many different functionally specialized areas of the brain" (Edelman & Tononi, p. 48). "This synchronous firing of widely dispersed neurons…is the basis for *the integration of perceptual and motor processes*" (ibid, added emphasis). And so, it might be hypothesized, the tuning of "muscular coordination" in the cerebellum plus the honing of "spatial-analytic abilities" in the parietal lobe will benefit and enhance activity throughout the rest of the nervous system, thus influencing overall states of consciousness. It really is all ecological; everything is connected to everything else.

Could it be further hypothesized that atrophy of the cerebellum through lack of "muscular coordination" challenges or diminution of the "spatial-analytic abilities" of the parietal lobe through dull or non-existent motor routines, with consequent reduction of synchronous neural activity, likewise will influence overall states of consciousness?

Perhaps it would be helpful to review the fundamentals:

> [C]ognition is a form of embodied action. Cognitive structures and processes emerge from recurrent sensorimotor patterns of perception and action. Sensorimotor coupling between organism and environment modulates, but does not determine, the formation of endogenous, dynamic patterns of neural activity, which in turn inform sensorimotor coupling (Thompson, 2005, p. 407).

"Sensorimotor coupling between organism and environment:" this has become a recurring theme; yet, in a way similar that the mind is not a "black-box," the environment is not a generic, uniform, pregiven slab – no, it has a multitude of expressions: There were rich, undisturbed ecologies through which early *Homo sapiens* migrated, during a time when the nervous system was still formative; there was a pastoral 'village' stage of development, as *Homo sapiens* put down roots and instituted agriculture; and then there was the rise of 'civilization,' introducing the highly artificial and artificed (meaning entirely human-made) environment of cities.

These days, there does not exist anywhere on Earth an ecology that has not been modified in some way by human use; therefore, it makes more sense to speak foremost of structural coupling to a *built* environment. Of built environments, the vast majority of humans live in settlements, and each of these settlements has an underlying and determining morphology. For the sake of introduction to the subject, I wish to examine now two of these morphologies, two of the most predominant and influential, two with entirely different origins and purposes. The first of these is called "organic" and the second is known as "orthogonal," or "grid." Kostof (1991, 1992) does a great job explaining and comparing these two different morphologies (and others), so please refer there for a comprehensive history. What I will do here is offer phenomenological accounts of what it is like to move through these morphologies as an "embodied agent," as a first step toward correlating neuroscience data and thus proposing a neurophenomenological interpretation. This approach will be more like Varela's, in that it will be theoretical, rather than Lutz's, which was empirical, using an EEG on the spot. Ideally, I would be wearing an fMRI "helmet" as I moved through the morphologies, recording neural dynamics with the machine as I simultaneously documented my perceptual experiences.

And now for the phenomenological accounts: Before documenting phenomenological perception of direct lived experience, it is first necessary to perform the *epoche*, the "bracketing" of prior disposition and habitual course of thought so that essences may be revealed. Since I have been trained in Vipassana meditation, and have instituted a regular practice, I use this technique to enter the *epoche*. Vipassana meditation begins with a preliminary called *Anapana*, which amounts to calmly focusing the attention on the breath as it enters and leaves the nostrils. The purpose is to notice any sensations that may be arising in that limited frame of reference. After a short period of practicing Anapana meditation, the mind begins to slow down, the inner chatter begins to subside, and a state of relative stillness permeates. It is this state of stillness, or equanimity, I want to enter as I approach my phenomenological task.

The "organic" phenomenological account was documented while moving through the streets of Siena, in Tuscany. The "grid" was perceived while moving through downtown Seattle. First, excerpts from the Tuscan account:

> The streets, the thoroughfares for walking, are much narrower here than any I've seen in North America. There is a comforting sense of enclosure with the rows of four-story houses on either side. Yet not stifling so. Even with four stories the sky can be detected over the buildings and forms a sort of umbrella overhead. The light seems to be coming from everywhere; that is, it is a 'luminescence' rather than a 'radiance.' Then again, it's getting late in the afternoon, so I'll have to come back later when the Sun is directly overhead…The street before me is curving and rising upon a hill. It seems to be gracefully following the topography of the hill. Perhaps this is one of the "goat trails" that Le Corbusier mocks? I feel a sense of anticipation to discover what is at the top of the hill. What new vista will open up? I can see that up ahead is some kind of an intersection because as I get closer I see the frontage of new buildings on a street that seems to enter the one I am on…There is a group of people coming toward me, strolling down the hill, looking like a pair of couples, young men and women, one of the women exaggeratedly slinging a bag in motion to her steps. There is plenty of room for all of us to pass – I bet six people could walk comfortably shoulder to shoulder – yet we seem to instinctively orient ourselves in the street so that there will be a polite passing. I smile as we pass saying "Buongiorno." One of the women responds with a dainty "Buongiorno" but the men in sunglasses just look at me (maybe thinking, "not another American!"). Just then I notice there is an elderly woman looking out of a third-story window above us. She seems to have access to the street without fully being part of it, kind of sheltered behind half-open shutters. Nevertheless our eyes meet so I tip my hat and she responds with a warm though demure smile. I can't help but wonder what her ancient flat must look like? Just then the peaceful scene is shattered by the loud whine of a motor-scooter racing down the hill. I feel safe with plenty of room but I look back to see the pair of couples taking evasive maneuvers by lining up against the building. Blasted internal combustion engines, leaving behind a noxious cloud…Now I've arrived at the top of the hill and it is indeed an intersection. To the left the crossing street seems to terminate after about 50 meters so I am assuming that is the boundary of this hill town. Beyond is a sunlit hill with apparent olive groves in between – a full Tuscan landscape that seems to be framed by the edges of the buildings. A beautiful composition! To the right, the crossing thoroughfare proceeds for some distance and then gradually turns down the hill. I can only imagine what might be down that way. I do notice the banners overhanging the streets change color in that direction. Just about the location where the

> street begins to turn the buildings give way to form a cozy little nook, just big enough to contain four tables with umbrellas. How charming! The tables are all full of people in intent animated conversation and I have to wonder if they are locals – *real* locals who live in the buildings surrounding. I would feel like an intruder to go sit at one of those tables, so I leave that direction a mystery…I continue up the thoroughfare I've been traversing as it begins to widen and level off. It's obvious I'm getting closer to the Campo, the central piazza, because it's starting to feel busy, more people and more sounds and smells. Suddenly, the tower of the Palazzo Pubblico pops impressively into view over the tops of the rows of houses, so I'm closer than I thought. What a splendid emblem for the town! Now the street begins to flow – and I do mean flow – slightly downward so I know I am entering the center. Direct sunrays are now beaming on some of the buildings in front of me: the Palazzo Pubblico. Crowds are gathered. I smell pizza. The length of the tower is now prominent, rising like a homing beacon. I see some railing bordering an open space which I assume to be the edge of the Campo. I need to politely negotiate my way through the crowds now because everybody seems to be hanging out in front of a shop or a food vendor, or maybe they're just taking shelter in the shade? There is a buzz of conversation and human interaction all around me. I feel to be part of something even though I'm just a tourist (phenomenology researcher). Then, finally, I make my way around the edge of the last building and there it is laid out before me: the famous Campo of Siena. It is far more glorious than I could have imagined, the whole scene! I feel a wave of emotion as tears begin to well up in my eyes. I lean back against the building for support, in the direct rays of the Sun, dropping my shades so that no-one will see my emotion. I want to stand here for a long time and soak it all up…

And now for a sample of the phenomenological account of moving as an embodied agent through the gridded morphology of downtown Seattle:

> I feel like I could have been transported to any downtown in North America, so generic is the scenery. There's the requisite Starbucks and there's the Subway. OK, begin moving – and I feel like I better keep moving cause the only people that stop are the one's asking for money. I guess it's called loitering if you stop around here. As I begin walking I look straight ahead. There's really no other place to look because the sidewalk is stretched forward like one of those moving escalators at the airport, only this one's in a deep canyon of skyscrapers. Just keep moving. There's someone walking toward me so I habitually move to the right so that they may pass, as if we were two cars on the road. I check out this person at a distance out of primate curiosity to see who they might be but I've learned from experience not to sustain the gaze cause people in downtown Seattle get mighty uncomfortable, almost fearful, if eye contact is made. Better to wear shades. Everybody has a distinct bubble. Everybody's a stranger. So at a certain safe distance I lower my gaze and look straight ahead until we pass, after which I can begin to look around again… It feels almost like I'm being *pushed* along, as by the momentum of not wanting to appear to be loitering, so I accelerate my steps…Now I am

approaching a corner: decision time. Where was I heading? Oh yea, two blocks up and four blocks over, then I should arrive at the bank. These corner decision-times are almost digital: upon arriving there are two and only two choices. Either proceed straight ahead or make a 90-degree turn. Since the "Don't Walk" sign is on ahead of me, I decide to turn right. That means my original calculation of two blocks up and four blocks over will need to be modified. Now, at the next corner decision-moment it will be two blocks up and *three* blocks over; unless the "Don't Walk" sign is on in that direction. Then I will turn left and proceed as usual. Either way, the goal is to get to my destination as quickly and efficiently as possible. Standing on a corner waiting for the light to change just wastes time – and besides, I'm always dimly concerned that someone coming up behind me is going to push me into the oncoming traffic…I'm approaching the next corner and it appears that there will be enough "Walk" time to make it through, so that means now two blocks over and two blocks up, if I have calculated correctly. I begin to accelerate even more to make it through the "Walk" time. As I pass the edge of the building at the corner I almost slam into somebody who was motivating at a 90-degree angle perpendicular to my trajectory. I quickly readjust without saying a word and proceed straight ahead. The street looks like it could go on forever in its straightness, though I know from experience that the grid gets re-oriented about twenty blocks down – and I could probably see that re-orientation if the terrain was perfectly flat. As it is there's a slight grade to break up the monotony…As I move efficiently forward toward my final goal, the bank, just a couple blocks away, I am impeded by a crowd standing at a bus-stop. There's no way to efficiently get around them as there are people walking toward me in the opposite direction, so I am forced to slow down. At this new gradual speed, waiting for an opening to emerge, I suddenly notice the people around me, almost like I can smell them. A portly fellow makes passing eye contact. It was only an instant but in that instant I could sense an almost innate humanness about him, a sort of light in the eye, though I surely would not want to pause long enough to make intimate contact. An opening emerges and so I resume my forward motion straight down the sidewalk. I arrive at the corner where I expect the bank to be but it is not there. Then I realize I must have miscalculated: It must have been *three* blocks up and four blocks over. A cold wind is gusting through the canyon like a venturi. I look down the sidewalk to my left and sense the bank must be in that direction. As I get closer, I start to notice the wide glass face that is the bank's exterior. As I arrive at the corner I make a special effort to orient myself. What corner is this anyway? Sixth and Spring. I make a mental note to try and remember that for next time…

Discussion

These were certainly two different phenomenological experiences. The "organic" morphology evoked a sense of wonder, prompting the use of qualifiers such as "beautiful," "charming," and "splendid." There seemed to be plenty of stimulation to keep the mind busy and engaged. The setting also facilitated a variety of spontaneous social interactions. There was a sense of "flow" that led inexorably to the "center." Once at the center, there arose a sort of timeless desire to perpetuate the situation and to revel in the feelings that had been stirred. Of course, that was the first time I had been to Siena so that made it extra special; still, the emotions were genuine and so must be reflective of the place.

The phenomenological experience of moving through the "grid" morphology was strikingly different. There was a sense of urgency to complete the mission as quickly and efficiently as possible – no time to "smell the roses" as they say. There appeared to be some disorientation, as if the setting evoked a sense of abstraction where one block looked like any other – or even where one city looked like any other. The method for "wayfinding" was to calculate grid coordinates, and these were subject to modification depending on the most efficient utilization of "Walk/Don't Walk" sign opportunities. There was a notable tendency towards unfriendly, guarded, perhaps even hostile, social relations – yet this phenomenon may have been more indicative of the "downtown" business district mood rather than of the morphology *per se*. It would be useful to conduct similar research in more of a "small town" grid (and there are plenty to choose from!) to discover whether a similar social attitude prevails, as well as if the same sense of disorientation manifests.

There are the phenomenological evaluations; now, what was happening neurologically during these two experiences? The answer can only be speculative for now – and I'm still at the beginning stages of piecing together this neurophenomenology of settlement morphology – yet I believe there are enough clues in the literature to make some informed conjectures.

First, "the parietal lobes are critical for abstracting spatial relations" (Gazzaniga, *et al*. 2009, p. 481), so that would be a good place to look for neural dynamics during movement through a morphology:

> The supplementary motor area and the premotor cortex receive information from association areas of the parietal and temporal cortex…The dorsal stream [of the visual association cortex], which terminates in the posterior parietal lobe, is involved in perception of location – the "where" of visual perception. In addition, the parietal lobes are involved in organizing visually guided movements – the "how" of visual perception. Besides receiving visual information about space, the parietal lobe receives information about spatial location from the somatosensory, vestibular, and auditory systems and integrates this information with visual information. Thus, the regions of the frontal cortex that are involved in planning movements receive the information they need about what is happening and where it is happening from the temporal and parietal lobes…[T]he parietal lobes contain spatial information…(Carlson, 2010, p. 278).

If the parietal lobes contain spatial information, I'm curious to know if this information is "isomorphic" to its surroundings; that is, is there a one-to-one correspondence between spatial morphology and neural morphology? In other words, to be blunt, would gridded morphology in the environment be reflected as grid-like neural patterning (i.e. linear, othrogonal)? And alternately, would organic morphology be reflected as organic neural patterning?

Apparently, this very issue was raised long ago by the gestalt psychologists. “In his 1947 book *Gestalt Psychology*, Kohler wrote: “The principle of isomorphism demands that in a given case the organization of experience and the underlying physiological facts have the same structure”” (Kohler, 1947, p. 301, as cited in Thompson, *et al*. 1999, p. 171).

> There are several points about Kohler’s principle of isomorphism that deserve mention. First, by the phrase “have the same structure” Kohler had in mind structural properties that are *topological*. Although the concept of neural-perceptual isomorphism has often been taken to mean a geometrical one-to-one mapping, Kohler clearly intended the isomorphism concept to have a topological [i.e. configurationally descriptive in mapping] sense. For example, he argued that spatial relationships in the visual field cannot correspond to geometrical relationships in the brain; they must correspond rather to functional relationships among brain processes (Thompson, *et al*. 1999, p. 171, original emphasis, referencing Kohler, 1929, pp. 136-41; 1930, pp. 240-49).

Thompson, *et al*. (1999), after raising the issue to clarify their own research program, do not arrive at a definite conclusion but rather leave it as, “Whether there are either spatial/topographic or topological/functional neural-perceptual isomorphisms in any given case is an empirical question for cognitive neuroscience to decide” (p. 181). Indeed! Even so, a neural-perceptual topological isomorphism – with the spatial information in the parietal lobes influencing other thought processes – does seem to correspond to Edelman’s theory of “global mapping” (1992, pp. 83-9) and Varela’s formulation of “resonant cell assemblies” (1995), an approach which “aims to map the neural substrates of consciousness at the level of large-scale, emergent and transient dynamical patterns of brain activity (rather than at the level of particular circuits or classes of neurons)” (Thompson & Varela, 2001, p. 418). Fell (2004, p. 716), coming from a “dynamical systems” perspective, prefers to label this phenomenon as “psychoneural homeomorphism:” “Coming back to the concept of a state space representation of neural and phenomenal states, the hypothesis of psychoneural homeomorphism asserts that the sets of neural and corresponding phenomenal states are topologically equivalent. Topological equivalence means that coming from the neural state space, topological structures are preserved in the phenomenal states, and vice versa.” It all comes back to the accepted, by now, observation: “Interactions with the world leave traces of experience in the brain. These traces are (partially) retrieved and used in the mental simulations that make up cognition. Crucially, these traces bear a resemblance to the perceptual/action [i.e. phenomenal] processes that generated them…” (Zwaan & Madden, 2005, p. 224, as cited in Adams, 2010, p. 624).

Conclusion

There is no shortage of hypotheses and perspectives from which to approach the proposal of a neurophenomenology of settlement morphology. In addition to "isomorphism," of particular relevance is research investigating the generation of "cognitive maps" in the hippocampus, associated with memory (Epstein, 2008; Hafting, *et al*. 2005; McNamara & Shelton, 2003). This cognitive neuroscience perspective is complemented nicely with environment-behavior research looking at such phenomena as "cognitive maps," "spatial cognition," and "wayfinding" (Kim & Penn, 2004; O'Neill, 1991; Weisman, 1981). Whereas the cognitive neuroscience research may be asking "why?" environment-behavior research is asking "how?"

John Ziesel has distinguished himself in the environment-behavior field. His important book *Inquiry by Design: Environment/Behavior/Neuroscience in Architecture, Interiors, Landscape, and Planning* (2006) was inspiration for the present study. Explains Ziesel (p. 146):

> In traditional environment-behavior studies, the physical environment is considered the context for and object of actions such as perception, memory, cognitive mapping, and use. The neurosciences tell us, however, that while environment is a contextual object [I much prefer the term 'array'] for minds to relate to, it also plays a central role in basic mental functions such as learning, memory, orientation, and perception. Only by including neuroscience in environment-behavior studies can we understand the interaction between environmental stimulus and behavioral response in ways that inform and improve design.

Design: that is the whole purpose of this study; for, if we understand how the environment influences consciousness then we can learn how to design environments that actually *enhance* consciousness. Expanded human potential, creativity, and self-realization will be the inevitable consequences.

John Paul Eberhard (2007, 2009) has intuited this. He founded The Academy of Neuroscience for Architecture to advance this understanding. Yet, as a trained architect, Eberhard has become accustomed to thinking in the limited terms of *individual buildings* – as has Harry Francis Mallgrave (2011), who wrote *The Architect's Brain: Neuroscience, Creativity, and Architecture.* The amazing discoveries being made in contemporary cognitive neuroscience are filtering down and influencing the design professions yet I want to suggest that far more meaningful results may be obtained by working with scales larger than individual buildings. That's why I use the blanket term "settlement:" what I'm referring to is ensembles, assemblages of buildings with varying functions and their associated streetscapes, plazas, monuments, nooks, edges, etc. – and including various ecological embellishments depending on the scale. The "cognitive map" of an individual building is far more limited in scope than the cognitive map of, say, a village (Lewenz, 2007; see also www.villagedesign.org). Eberhard (2009, p. 6) claims that "the architectural and neuroscience communities have failed to bridge their intellectual gap." Neurophenomenology is precisely the tool to move "beyond the gap" (Roy, *et al*. 1999), as the intellectual foundation of a new design science.

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